

ON THE ORIGIN OF SPECIES BY MEANS OF NATURAL SELECTION OR THE PRESERVATION OF FAVORED RACES IN THE STRUGGLE FOR LIFE. BY CHARLES DARWIN, M. A., etc. LONDON: JOHN MURRAY: Reprint, D. APPLETON & Co., 1860.

It has been calculated, on data that may be considered as tolerably satisfactory, that the number of specific types of organic life at present existing on the globe considerably exceeds HALF-A-MILLION.

Enormous as this aggregation is, it is at the same time probable that each of the long suite of Geologic ages—all characterized by their own systems of animal and vegetable life—was at least as rich as at present in the number and variety of its organic structures.

Embracing in the imagination this vast ensemble of organisms—this ocean of forms amid which creative energy has sported—we realize the magnitude of the problem that seeks to account for the genesis of these millionfold incarnations of life. We touch, in fact, the grand and complex question of the Origin of Species—that mystery of mysteries, as one of our greatest philosophers has styled it.

With regard to this question the doctrine that has long prevailed is, that each species has been independently created. The idea of the *permanence of species* is, in fact, embodied in one shape or another in every definition of the term which has been framed. All the most eminent palæontologists, CUVIER, OWEN, and AGASSIZ among them, and all our greatest geologists, LYELL, MURCHISON, and the rest, have unanimously, often vehemently, maintained the immutability of species. No article of scientific faith is of more canonical authority, and though some bold speculator like LAMARCK, or some ingenious theorist like the author of the *Vestiges*, has ventured to question the soundness of its basis, yet it has given no outward sign of instability, and is commonly regarded as one of those doctrines which no man altogether in his right senses would set himself seriously to oppose.

Meanwhile, Mr. DARWIN, as the fruit of a quarter of a century of patient observation and experiment, throws out, in a book whose title at least has by this time become familiar to the reading public, a series of arguments and inferences so revolutionary as, if established, to necessitate a radical reconstruction of the fundamental doctrines of natural history.

Mr. DARWIN's mode of accounting for the diversity of the specific forms of organic life, differs alike from the doctrine of LAMARCK, (who made transmutation to depend mainly upon the efforts of the animal,) and from the hypothesis of the author of the *Vestiges* (who found the solution of the problem in the idea of consecutive development.)

It differs also, let us say, in having for its basis some undeniable facts.

Not by dubious speculations on the action of a "chemico-electric" operation on "germinal vesicles," but by the synthesis of a wide series of appreciable and daylight facts in the structure of animals and plants, does Mr. DARWIN sustain his startling theory. Rising from this synthesis, he ascends with the swoop and force of analogy to the suggest and audacious statement that "all the organic beings which have ever lived on this earth have descended from some one primordial form, into which life was at first breathed!"

It is clear that here is one of the most important contributions ever made to philosophical science; and it is at least behooving on scientists, in the light of the accumulation of evidence which the author has summoned in support of his theory, to reconsider the grounds on which their present doctrine of the origin of species is based.

## II.

In the construction of his argument, Mr. DARWIN takes his *point de départ* from the striking modifications which animals and plants are susceptible of undergoing in domestication. The astonishing results achieved by English breeders in the modification of horses, dogs and cattle, furnish him fruitful exemplifications of the amazing versatility of animal structures. Indeed, breeders habitually speak of an animal's organization as something quite plastic, which they can model almost as they please.

But it is in the wonderful variations which domestic pigeons undergo that he finds his most striking illustrations of variation under domesticity. *In re* pigeons, Mr. DARWIN is immense. And really, the diversity of breeds is something astonishing: marked anatomical and physiological characteristics distinguish the various breeds; at least a score of pigeons might be selected which, if shown to an ornithologist, and he were told that they were wild birds, would certainly be ranked by him as well-defined species, and some even as distinct genera; and yet, great as the differences are between the breeds, it is the universal opinion of naturalists that all have descended from the Rock pigeon!

The key to this production of varieties under domestication is found in man's power of accumulative selection: nature gives successive variations: man adds them up—such is DARWIN'S striking expression—in certain directions useful to him.

Is it not plain that this capacity for undergoing such modifications exhibits an elasticity of constitution which would equally tend to adapt these animals to varieties of natural conditions, and thus to originate diversified races which would perpetuate themselves without man's interference?

Species, then, are to some extent, and sometimes to a quite remarkable extent, variable—modifiable. There is a certain versatility in animal structures. They are more or less flexible—more or less plastic.

One of the chief powers in this tragedy of transmutation, this new diviner fluids in the *Struggle for Existence*—an expression which he employs in a large and metaphorical sense.

A struggle for existence inevitably follows from the high geometrical ratio of increase which is common to all organic beings. There is no exception to the rule that every organic being naturally increases at so high a rate that, if not destroyed, the earth would soon be covered by the progeny of a single pair. Even slow-breeding man has doubled in twenty-five years, and at this rate, in a few thousand years, there would literally not be standing-room for his progeny. Of this prodigious capacity of increase Mr. DARWIN furnishes a copious series of illustrations; but one of the most striking that has ever come under our notice is one which he does not give, and which we recall in LINNÆUS. The Aphides, or plant-lice, have been found to propagate so rapidly that in the course of a few months, if all interference were excluded, no fewer than 1,000,000,000,000,000,000 would be evolved from a single individual—an amount which only becomes conceivable when we learn that this mass of life would weigh somewhere about as much as five hundred millions of stout men!

Such is DARWIN'S doctrine of the *Struggle for Existence*. Far more individuals being produced than can possibly survive, there must in every case be a struggle for existence, either one individual with another of the same species, or with the individuals of a distinct species, or with the physical conditions of life.

It is the doctrine of MALTHUS applied with manifold force to the whole animal and vegetable kingdoms.

The law of the *Struggle for Existence* Mr. DARWIN finds the key to many secret facts in the economy of nature. He records many striking instances of how complex and unexpected are the checks and relations between organic beings, which have to struggle together in the same country. By what a web of complex relations are plants and animals most remote in the scale of nature bound together! How, for example, could the domestic cats in any village be imagined to determine the frequency of certain flowers in that district? Mr. DARWIN shall make answer in his own words:

"I have reason to believe that humble-bees are indispensable to the fertilization of the heartsease. Hence I have very little doubt that if the whole

genus of humble-bees became extinct or very rare in England, the heartsease and red clover would become very rare, or wholly disappear. The number of humble-bees in any district depends in a great degree on the number of field-mice, which destroy their combs and nests; and Mr. H. NEWMAN, who has long attended to the habits of humble-bees, believes that 'more than two thirds of them are thus destroyed all over England.' Now the number of mice is largely dependent, as everyone knows, on the number of cats; and Mr. NEWMAN says, 'Near villages I have found the nests of humble-bees more numerous than elsewhere, which I attribute to the number of cats that destroy the mice!'

One would think, in reading Mr. DARWIN'S string of sequences, that the ingenious author of the "House that Jack Built" had intended to imbue the infant mind with a knowledge of high scientific truths: for the whole may be expressed, after the fashion of the immortal legend, in the following concise riddle: "This is the old woman, that kept the cat, that ate the mouse, that killed the humble-bees, that fertilized the clover!"

In the midst of this constant and complex struggle for existence, there is a formative principle ever at work modifying the structure of organized beings. This, Mr. DARWIN calls the law of Natural Selection. The doctrine of Natural Selection is the radical thought of the book.

We have seen that there is something plastic in all organisms—a certain versatility, susceptible of producing varieties from species, susceptible of modifying the structure to a certain extent. We have also seen that man, by selection, can certainly produce great results, and can adapt organic beings to his own uses, through the accumulation of slight but useful variations, given to him by the hand of Nature.

Nature is constantly at work doing the same thing. Whatever variation occurring among the individuals of any species of animals or plants is in any way advantageous in the struggle for existence, will give to those individuals an advantage over their fellows, which will be inherited by their offspring until the modified variety supplants the parent species. By the steady accumulation, during long ages of time, of slight differences, each in some way beneficial to the individual, arise the various modifications of structure by which the countless forms of animal and vegetable life are distinguished from each other.

It may be said that Natural Selection is daily and hourly scrutinizing, throughout the world, every variety, even the slightest—rejecting that which is bad, preserving and adding up all that is good; silently and insensibly working, whenever and wherever opportunity offers, at the improvement of each organic being. We see nothing of these slow changes in progress, until the hand of time has marked the lapse of ages, and then so imperfect is our view into long past geological epochs, that we only see that the forms of life are now different from what they formerly were.

Through this long-continued course of modification, Mr. DARWIN has it that the slight differences characteristic of varieties of the same species tend to be augmented into the greater differences characteristic of species of the same genus.

But what are the real relations of varieties to species? Mr. DARWIN puts in the strongest light the fact that there is no absolute difference between these, but that they shade off into each other. Well marked varieties he regards as simply "incipient species" and species he looks upon as just strongly-marked and well-defined varieties. Few well-marked and well-known varieties can be named which have not been ranked as species by at least some competent judges. Certainly no clear line of demarcation has as yet been drawn between species and sub-species, and again between sub-species and well-marked varieties. These differences blend into each other in an insensible series: and a series impresses the mind with the idea of an actual passage.

From this point Mr. DARWIN advances to the examination of the Laws of Variation.

And here he frankly confesses our ignorance is profound. Not in one case out of a hundred can we pretend to assign any reason why this or that part differs, more or less, from the same part in the parents. But Mr. DARWIN maintains that, wherever we have the means of instituting a comparison, the same laws appear to have acted in producing the lesser differences between varieties of the same species, and the greater differences between species of the same genus.

Among efficient causes, however, he numbers the external conditions of life, as climate, food, &c. Habit in producing constitutional differences, and use in strengthening, and disuse in weakening and diminishing organs, seem to have been more potent in their effects. Homologous parts tend to vary in the same way, and homologous parts tend to cohere.

Among the subtlest of the Laws of Variation is the principle of correlation of growth—a most important subject, most imperfectly understood. According to this doctrine the whole organization is so tied together during its growth and development, that when slight variations in any one part occur, other parts become modified. An instance of this is seen in the correspondence in length between the jaws and limbs, thus verifying the doctrine in transcendental anatomy that the lower jaw is homologous with the limbs. In monstrosities, the correlations between quite distinct parts are very curious, and many whimsical instances are given in GEOFFROY ST. HILAIRE'S great work (*Anomalies*). What can be more singular than the relation between blue eyes and deafness in cats, and the tortoise-shell color with the female sex; or again, the relation between the hair and teeth in the naked Turkish dog—though here probably homology comes into play?

"It is interesting," says Mr. DARWIN, "to contemplate an entangled bank, clothed with many plants of many kinds, with worms crawling through the damp earth, with birds singing on the bushes, and with various insects flitting about." In this doctrine all these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, are looked upon as being produced by laws acting round us. These laws, taken in the largest sense, being Growth with Reproduction; Inheritance, which is almost implied by reproduction; Variability, from the indirect and direct action of the external conditions of life, and from use and disease; a rate of increase so high as to lead to a *Struggle for Life*, and as a consequence to Natural Selection, entailing divergence of character, and extinction of less-improved forms.

Such is Mr. DARWIN'S theory. Easy enough to state, it is impossible to give within much less space than the author has himself employed any idea of the mass of argument and illustration by which this startling theory is sustained and defended. The book is indeed, as he declares, "one long argument," and the theory can only be fully appreciated by patiently following the many consecutive and collateral lines of evidence which he converges on the illustration of a doctrine which is with him manifestly a profound conviction.

## III.

Shall we frankly declare that, after the most deliberate consideration of Mr. DARWIN'S arguments, we remain unconvinced?

The book is full of a most interesting and impressive series of minor verifications; but he fails to show the points of junction between these, and no where rises to complete logical statement.

The difficulties, of course, are enormous. This he frankly acknowledges. "Some of them are so grave that to this day I can never reflect on them without being staggered." Such are his own *verba* and noble words.

He thinks, however, they are more apparent than real. We fear they are very real. To us insurmountable.

Ten times the space given to this article would not suffice for any adequate treatment of this vast and complicated subject. In a very general way, though, we may touch on a few topics. To this and every hypothesis which assumes the gradual transition from species to species, from genus to genus, geology opposes the irrefragable fact of the utter absence of all transitional links, and the clear

and clear identity of specific forms. As on Mr. DARWIN'S theory an interminable number of intermediate forms must have existed, linking together all the species in each group by gradations as fine as our present varieties, we have a perfect right to ask, why do we not see these linking forms all around us? Why are not all organic beings blended together in an inextricable chaos?

Mr. DARWIN answers this difficulty by urging the extreme imperfection of the geological record. That the geological record is imperfect all will admit; but few will be inclined to admit that it is imperfect to the degree Mr. DARWIN'S doctrine requires.

This draft on the imagination of millionfold transitional organisms to fill up the hiatus between fossil species, is succeeded by a hypothesis still more startling. For, unhappily for the theory, when we go back even to the first apparition of life in the palæozoic rocks of the Silurian system, we find ourselves among organic structures specifically just as distinct as those our dredgers now take off our coasts. To obtain a background for this abrupt appearance of distinct types, his theory postulates that "before the lowest Silurian stratum was deposited, long periods elapsed—as long as, or probably far longer than, the whole interval from the Silurian age to the present day; and that during these vast but quite unknown periods of time, the world swarmed with living creatures."

To the question why we do not find records of these vast primordial periods, Mr. DARWIN fairly admits that he "can give no satisfactory answer," but tries to satisfy the inquirer by the assurance that his witnesses are all submerged! At a period immeasurably antecedent to the Silurian epoch, he affirms, continents may have existed where oceans are now spread out, and clear and open seas may have existed where our continents now stand. Nor should we be justified in assuming that if, for instance, the bed of the Pacific Ocean were now converted into a continent, we should there find formations older than the Silurian strata, and in those formations, one after another, throughout millions of ages, the successive forms of the primitive fauna and flora were silently entombed.

Amid this pile of unsupported conjecture there is but one consideration that we may profitably keep in mind—that it is an admission in Geology that the absence of all organic remains in a particular deposit is no proof whatever that animal life did not abundantly exist during the whole period of that deposit. An azoic rock is no necessary proof of an azoic period. It is even a doctrine of the most advanced school of English Geologists, that the fossils of the Silurian formation are by no means to be regarded as the first apparition of organic life, and the present writer had an opportunity last Summer, in company with Sir WM. LOGAN, of examining a fossil from the Laurentian rocks of Canada—far older than the Silurian strata—which if it holds its authenticity, must be the intimation of a new and elder world of organic forms, into which research and induction may yet be prolonged.

The fundamental limitation of Mr. DARWIN'S theory springs from a fact in his own mental structure. He is but a *Naturalist*. Of that lofty series of speculations embracing the doctrine of Homologies, Embryology and Unity of Type, he seems ignorant in any profound sense. It is only, we apprehend, by converging the prophetic omens and intuitions from these grand reaches of science that light can be thrown on the mysterious problem of the Origin of Life. OKEN has profoundly remarked that "the animal system cannot be arbitrarily disposed of according to this or that organ, just as it may chance to meet the eye, but only in accordance with the rigid prescripts of the animal body's genesis."

The conception of the Unity of Nature passed like a new spirit into science, at the opening of the present century. It is one of those flaming thoughts the soul projects—plendid prophecies that become the light of all our science and all our day. Applied, within these few years, by ST. HILAIRE, OKEN, CARUS, SWENSON, OWEN, to Anatomy, it has revealed a sublime unity of design and composition throughout the whole hierarchy of animate organisms. GEOFFROY ST. HILAIRE formulated it in the grand conception that *there is but one animal*. Embryology has developed the doctrine that all animals resemble each other in their early stages, and Transcendental Anatomy reveals that the higher orders of animals pass through transitory embryonic stages, that are the permanent states of the lower classes. Polyp, mollusk, turtle, fish, bird, are successive incarnations of that divine idea that finds its latest vestment in the glorious garb of the human form.

## IV.

But it would be to fail to extract the best uses of this book, to expect a finality. Its best suggestion is to show us how far we are from the possibility of any finality. Of how many things are we ignorant. "And we do not know how ignorant we are," adds Mr. DARWIN.

No one ought to feel surprise at much remaining as yet unexplained in regard to the origin of life. Think of the baffling problem it presents—the sphinx-riddle of life, the mother-mystery ever enveloping us! "It is good clearly to understand," said MALBRANCHE, and with a very deep meaning, "that there are some things utterly incomprehensible." Indeed, considering the limitations of science, what is there for the wisest but to work in the spirit of the Shakespearean utterance:

"In Nature's infinite Book of Secrecy  
A little I can read."

But while it seems to our apprehension that, in the very nature of things, the problem of life yet remains to receive epic statement, we at the same time look upon the contribution of Mr. DARWIN as a most legitimate and successful attempt to extend the domain of science—as, indeed, the most important of modern contributions to philosophical zoology.

And in respect of the great spinal thought of Mr. DARWIN'S theory, we are persuaded that the doctrine of progressive modification by Natural Selection, will give a new direction to inquiry into the real genetic relationship of species, existing and extinct,—will, in fact, make a revolution in Natural History.

It will give a new and sure basis of classification. Indeed, this grand fact of the grouping of all organic beings seems inexplicable on any other theory. Read the interminable disputes of the naturalists as to what are species and what varieties, and you will see what a scientific chaos classification up to this day is. How the cumbersome catalogues of species increase! Meanwhile the difficulties increase, also, instead of diminishing with the extension of their researches.

That is a great fact, too, which Mr. DARWIN so impressively teaches—the imperfection of the geological record—and must go largely to modify existing palæontologic conceptions.

And what a vast background he lights up! What flowing æons! mark the ascent from the Silurian Mollusks to man—gulfs of time over which the mind grows dizzy in the attempt to gaze, and we feel the shiver of eternity pass over us! It is well to feed the mind with this sense of the amplitude of time, as a counter-agent of our petty and contracted chronologies.

It is the leading idea of modern science that we need not go in search of any other causes than those which are at present in action, for an explanation of the phenomena of Nature. Modern geology has banished the notion of sudden cataclysms, by showing that the same agencies are now at work which have brought about all the wonders of the up-piling of the strata of the globe. We are thus introduced into the grand idea of growth—of the enormous effect of existing agencies, when spread over a great period of time.

DARWIN puts himself abreast these same tendencies. And just as LYELL has banished from Geology the notion of sudden cataclysms, DARWIN threatens to banish from Zoology the notion of sudden creations. Together, we feel justified in saying, they have laid the foundation of one of the mightiest changes in philosophical thought. It is certainly more in accordance with our ideas of the philosophy of causation to believe that the en-

tire hierarchy of animate organisms are the result of the continuity of one mode of operation throughout the whole period that has elapsed since life was first introduced into our planet. It harmonizes better with our highest ideas of divine foresight, to believe that the scheme of evolution was originally made so perfect as to require no subsequent interference. We have no sympathy with those who, to see the admirable language of BARRÉ POWELL—"behold the Deity more clearly in the dark than in the light—in confusion, interruption and catastrophe, more than in order, continuity and progress."

## V.

The most important contribution to modern thought is undoubtedly the indirect teachings of physical science. For, magnificent though the direct teachings be, the indirect are perhaps still more wonderful: the former have relation but to the material world, while the latter influence the whole of man's speculative activity. Indeed the only part of science that can ever profoundly touch the great laity are its glorious indirections—its grand out-croppings of truth. In this regard there is much for science yet to attain: science needs literature just as much as literature needs science. He is the master of science who makes his facts but initial, leading to heights where new vistas open in flashes of beauty and repose. It is a significant fact that certain propositions recommend themselves and find acceptance even though not fortified by authority. They seem to find metaphysical support and interior warranties. Who can fail to see that such doctrines as the Nebular hypothesis, the doctrine of Development, &c., aside altogether from their scientific validity, have an indirect import to the culture, far more potent than all their direct bearings?

It would seem as if the doctrine of "attractions proportioned to destinies" held equally true in science as in sociology. HARVY'S discovery of the circulation of the blood is recorded to have found acceptance from no physician over forty years old. Perhaps DARWIN felt that to his own theory some such elective affinities might apply. "I look," says he, towards the close of the volume, "with confidence to the future, to young and rising naturalists, who will be able to view both sides of the question with impartiality."

In that future to which he looks forward, he will not, we apprehend, be regarded as having drawn the cosmic circle of life, but rather as having indicated one of its arcs. At all events, it seems to be a historic law that the greater portion of truths in the theory of nature first appear as purple mirages—ruddy and auroral streaks gilding the matin of man's mind; but the appointed time duly brings up the perfect thought, fraught with the wealth of invisible climes, and flooding the age with the sunlight of science.